Competency 1.7 **Industrial hygiene personnel shall demonstrate a working level knowledge of sample analysis, including the use of appropriate laboratory techniques.**

1. Supporting Knowledge and Skills

a. Describe the following:
- Selection of proper analytical instruments/techniques
- Sensitivity/specificity of the analytical technique
- Precision versus accuracy
- Instrument bias
- Interferences in sampling
- Principles of instrument operation

b. Discuss laboratory data recording requirements.

c. Discuss the fundamentals of operating analytical equipment including zeroing and the use of standards.

d. Discuss the following laboratory concerns and their effect on sample analysis.
- Quality assurance
- Chain of custody (samples and results)
- Physical security of samples
- Personnel safety
- Equipment maintenance
- Laboratory management

2. Recommended Reading

Review

- OSHA *Technical Manual*, 2nd Edition or later edition, U.S. Department of Labor, Occupational Safety and Health Administration.
- Patty's *Industrial Hygiene and Toxicology*, 4th Edition, Volume I, Chapters 15, "Quality Control;" 16, "Calibration;" and 27, "Industrial Hygiene Sampling and Analysis."

3. Summary

In general, only the industrial hygienists who direct industrial hygiene laboratories require detailed knowledge of industrial hygiene laboratory analysis. It is, however, important that any industrial hygienist sample or ensure sampling consistent with standardized local SOPs; the manufacturer's manuals; and NIOSH, OSHA, or other reference methods, to ensure that samples provided to the laboratory are capable of being analyzed and quantified appropriately. One of the best means of guaranteeing the value of samples is regular communication with the laboratory performing the analysis.

In communication with the laboratory, there is the possibility that the use of technical terminology relating to analysis may be used. While the industrial hygienist in the field will rarely be called upon to make technical decisions relating to analytical subjects, passing familiarity with a few terms and their applicability may be desirable. The DOE industrial hygienist might also be required to assess contractor industrial hygiene laboratory qualifications and competence, so at least familiarity with analytical terminology may be doubly useful.

Specificity for a particular analyte is one requirement of an acceptable analytical method. There is relatively little value in analytic results when it can be realistically asserted that the sample measured contaminants other than those desired because of lack of specificity of method.

The degree of sensitivity required will be determined by the amount of contaminant anticipated, and reason for the sample. If low concentrations are anticipated, the more sensitive, the better. If only screening for a chemical is performed, low sensitivity may be desirable to ensure that the concentration in the atmosphere does not exceed the operating range of the instrument.

Precision is the degree to which the method is repeatable; accuracy is the degree to which results truly indicate the level of contaminant.

Instrument bias refers to the instrument's systematic deviations from accuracy.

Interferences are contaminants that influence the outcome of the analytical results, either high or low. For both instruments and recognized analytical methods, interferences are listed and it is incumbent on the industrial hygienist to be familiar with them or account for them before sampling.

Fundamental to the operation of a laboratory analytical instrument is the establishment of a calibration curve that defines the relationship between the instrument output and the contaminant level in its sample. At minimum, this curve requires the plotting of the instrument determination of zero concentration and several laboratory standard concentrations to complete the curve. Most field instruments may also require calibration with a standard before use in order to demonstrate instrument status.

Quality assurance (QA) comprises the independent checks the laboratory makes on the accuracy of its own analyses. The program may be narrowly focused on analysis or more broadly directed at documentation and all laboratory processes. QA of analyses may involve the blind testing of samples provided from outside the laboratory or may involve internal comparisons between results provided by individual laboratory personnel.

At a minimum, sufficient chain of custody must be established to ensure security and traceability of samples after their arrival and through analysis.

Physical security is required along with chain of custody of samples prior to analysis; it is essential to be able to assert that the sample analyzed reflected conditions sampled in the field.

4. Suggested Exercises

Please refer to Scenarios 5 and 6 in the Scenario section of this document.